

Influence of Biomass Cofiring on PM_{2.5} Ash Produced in a 7-kW Coal Combustion System

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Summary

At the Energy & Environmental Research Center, two Powder River Basin (PRB) coals and an eastern bituminous coal have been cofired with biomass fuels in a 7-kW downfired combustor. The biomass fuels were sunflower hulls, hybrid poplar, wheat straw, wood chips, and alfalfa. All of the biomass fuels, when cofired with PRB coal, showed a shift in the particle-size distribution of the ash to lower amounts of PM_{2.5} when compared to the parent coal. The hybrid poplar, wheat straw, and alfalfa were also cofired with an eastern bituminous coal. The hybrid poplar and the alfalfa showed a similar shift to lower amounts of PM_{2.5} ash particles when compared to the parent coal, as seen in the PRB cofiring tests. This shift to a larger particle-size distribution is likely due to the interaction of alkali and alkaline-earth element components of the biomass with the silicate and clay materials in the coal. The alkali and alkaline-earth materials in biomass can be highly volatile and condense out on the surface of silicate- and clay-derived ash particles, causing the development of lower-melting-point phases and a sticky surface. These lower-melting-point phases can then aid in the development of larger particles by sticking two or more particles together, shifting the particle-size distribution to larger values. Biomass cofiring may be an effective way to reduce PM_{2.5} emissions in coal combustion systems. The wheat straw when cofired with the eastern bituminous coal showed an increase in PM_{2.5} ash particles when compared to the parent coal. This may be due to the high silica phytolith content of the wheat straw and the low alkali and alkaline-earth content of both the coal and the biomass, allowing for less development and interaction of sticky particles to increase particle size. All of the biomass materials in this study are rich in chlorine. This volatile material condensed out onto the surface of the ash particles, enriching the PM_{2.5} in chlorine.

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